

CLAIMS

1. A system for providing power to a load, the system comprising:
5 a first input to receive AC power from a first AC power source;
a second input to receive AC power from a second AC power source;
a third input to receive DC power from a first DC power source;
an output that provides output AC power to the load; and
converter circuitry, coupled to the first, second and third inputs and the output,
10 adapted to provide the output AC power derived from at least one of the first AC power
source, the second AC power source and the first DC power source.
2. The system of claim 1, further comprising a first bypass device coupled to the
first input and the output and controllable to operate in a bypass mode to couple the first input
15 to the output to provide AC power from the first AC power source directly to the output,
bypassing the converter circuitry.
3. The system of claim 2, further comprising a second bypass device coupled to
the second input and the output and controllable to operate in a bypass mode to couple the
20 second input to the output to provide AC power from the second AC power source directly to
the output, bypassing the converter circuitry.
4. The system of claim 3, wherein the converter circuitry includes a plurality of
controllable switches, each of the controllable switches being coupled to one of the first,
25 second and third inputs to control current draw by the converter circuitry from the first AC
power source, the second AC power source and the first DC power source; wherein, in a first
power source transition mode, the converter circuitry is adapted to detect an input AC voltage
waveform period of the first AC power source and to control the controllable switches such
that the converter circuitry draws current from the first AC power source during a first portion
30 of the period and the converter circuitry draws current from the first DC power source during
a second portion of the period for multiple periods.

5. The system of claim 4, wherein, in a second power source transition mode, the converter circuitry is adapted to detect an input AC voltage waveform period of the second AC power source and to control the controllable switches such that the converter circuitry draws current from the second AC power source during a first portion of the period and the converter circuitry draws current from the first DC power source during a second portion of the period for multiple periods.

6. The system of claim 5, further comprising a fourth input to receive DC power from a second DC power source, and wherein the converter circuitry is coupled to the fourth input through a controllable switch that is controlled in the first transition mode to draw current from the second DC power source during the first portion of the period for multiple periods.

7. The system of claim 6, wherein the converter circuitry includes a first DC regulator circuit having an input and having an output that produces a first DC voltage, and a second DC regulator circuit having an input and having an output that produces a second DC voltage, and wherein the input of the first DC regulator circuit is coupled to the first input of the system through a first one of the plurality of controllable switches, the input of the first DC regulator circuit is coupled to the second input through a second one of the plurality of controllable switches, the input of the first DC circuit is coupled to the third input through a third one of the plurality of controllable switches, the input of the second DC regulator is coupled to the first input of the system through a fourth one of the controllable switches, the input of the second DC regulator is coupled to the second input of the system through a fifth one of the controllable switches, and the input of the second DC regulator is coupled to the fourth input of the system through a sixth one of the plurality of controllable switches.

8. The system of claim 7, wherein the first DC voltage has approximately the same magnitude and opposite polarity of the second DC voltage.

9. The system of claim 8, further comprising a DC to AC converter coupled to the outputs of the first and second DC regulator circuits and the output of the system to provide output AC power derived from the first DC voltage and the second DC voltage.

10. The system of claim 9, wherein each of the controllable switches includes a thyristor.

5 11. The system of claim 10, further comprising the first DC source and the second DC source with a source voltage of the first DC source being of approximately equal magnitude and opposite polarity of a source voltage of the second DC source.

10 12. The system of claim 1, wherein the converter circuitry includes a plurality of controllable switches, each of the controllable switches being coupled to one of the first, second and third inputs to control current draw by the converter circuitry from the first AC power source, the second AC power source and the DC power source; wherein, in a first power source transition mode, the converter circuitry is adapted to detect an input AC voltage waveform period of the first AC power source and to control the controllable switches such
15 that the converter circuitry draws current from the first AC power source during a first portion of the period and the converter circuitry draws current from the first DC power source during a second portion of the period for multiple periods.

20 13. The system of claim 12, wherein, in a second power source transition mode, the converter circuitry is adapted to detect an input AC voltage waveform period of the second AC power source and to control the controllable switches such that the converter circuitry draws current from the second AC power source during a first portion of the period and the converter circuitry draws current from the first DC power source during a second portion of the period for multiple periods.

25 14. The system of claim 12, further comprising a fourth input to receive DC power from a second DC power source, and wherein the converter circuitry is coupled to the fourth input through a controllable switch that is controlled in the first power source transition mode to draw current from the second DC power source during the first portion of the period for
30 multiple periods.

15. The system of claim 14, wherein the converter circuitry includes a first DC regulator circuit having an input and having an output that produces a first DC voltage, and a second DC regulator circuit having an input and having an output that produces a second DC voltage, and wherein the input of the first DC regulator circuit is coupled to the first input of the system through a first one of the plurality of controllable switches, the input of the first DC regulator circuit is coupled to the second input through a second one of the plurality of controllable switches, the input of the first DC circuit is coupled to the third input through a third one of the plurality of controllable switches, the input of the second DC regulator is coupled to the first input of the system through a fourth one of the controllable switches, the input of the second DC regulator is coupled to the second input of the system through a fifth one of the controllable switches, and the input of the second DC regulator is coupled to the fourth input of the system through a sixth one of the plurality of controllable switches.

16. The system of claim 14, wherein the first DC voltage has approximately the same magnitude and opposite polarity of the second DC voltage.

17. The system of claim 15, further comprising a DC to AC converter coupled to the outputs of the first and second DC regulator circuits and the output of the system to provide output AC power derived from the first DC voltage and the second DC voltage.

18. The system of claim 12, wherein each of the controllable switches includes a thyristor.

19. The system of claim 14, further comprising the first DC source and the second DC source with a source voltage of the first DC source being of approximately equal magnitude and opposite polarity of a source voltage of the second DC source

20. A system for providing power to a load, the system comprising:
a first input to receive AC power from a first AC power source;
a second input to receive AC power from a second AC power source;
a third input to receive DC power from a first DC power source;
an output that provides output AC power to the load; and

converter means, coupled to the first, second and third inputs, for providing output power derived from at least one of the first AC power source, the second AC power source and the first DC power source.

5 21. The system of claim 20, further comprising bypass means for selectively providing AC power from the first AC power source directly to the output, bypassing the converter means.

 22. The system of claim 21, wherein the bypass means include means for
10 selectively providing AC power from the second AC power source directly to the output, bypassing the converter means.

 23. The system of claim 22, wherein the converter means includes means for
15 transitioning a draw of input current by the converter means from the first AC power source at the first input to the first DC power source at the third input, such that during a first transition period, input current is drawn by the converter means alternately from the first AC power source and the first DC power source.

 24. The system of claim 23, wherein the converter means includes means for
20 transitioning a draw of input current by the converter means from the first DC power source at the third input to the second AC power source at the second input, such that during a second transition period, input current is drawn by the converter means alternately from the first DC power source and the second AC power source.

25 25. The system of claim 24, further comprising a fourth input to receive DC power from a second DC power source, and wherein the converter means includes means for transitioning a draw of input current by the converter means from the first AC source at the first input to the second DC source at the fourth input, such that during the first transition
30 period, input current is drawn by the converter means alternately from the first AC source and the second DC source.

26. The system of claim 25, wherein the converter means includes means for transitioning a draw of input current by the converter means from the second DC power source at the fourth input to the second AC power source at the second input, such that during the second transition period, input current is drawn by the converter means alternately from
5 the second DC power source and the second AC power source.

27. The system of claim 26, wherein the converter means includes regulator means for producing a first regulated DC voltage, and a second regulated DC voltage.

10 28. The system of claim 27, wherein the first regulated DC voltage has approximately the same magnitude and opposite polarity of the second regulated DC voltage.

29. The system of claim 28, further comprising means for converting the first regulated DC voltage and the second regulated DC voltage to an AC voltage to provide
15 output AC power.

30. The system of claim 29, further comprising the first DC power source and the second DC power source with a source voltage of the first DC power source being of approximately equal magnitude and opposite polarity of a source voltage of the second DC
20 power source.

31. The system of claim 20, wherein the converter means includes means for transitioning a draw of input current by the converter means from the first AC power source at the first input to the first DC power source at the third input, such that during a first
25 transition period, input current is drawn by the converter means alternately from the first AC power source and the first DC power source.

32. The system of claim 20, wherein the converter means includes means for transitioning a draw of input current by the converter means from the first DC power source at the third input to the second AC power source at the second input, such that during a
30 second transition period, input current is drawn by the converter means alternately from the first DC power source and the second AC power source.

33. The system of claim 32, further comprising a fourth input to receive DC power from a second DC power source, and wherein the converter means includes means for transitioning a draw of input current by the converter means from the first AC power source at the first input to the second DC power source at the fourth input, such that during the first transition period, input current is drawn by the converter means alternately from the first AC power source and the second DC power source.

34. The system of claim 33, wherein the converter means includes means for transitioning a draw of input current by the converter means from the second DC power source at the fourth input to the second AC power source at the second input, such that during the second transition period, input current is drawn by the converter means alternately from the second DC power source and the second AC power source.

35. The system of claim 20, wherein the converter means includes regulator means for producing a first regulated DC voltage, and a second regulated DC voltage.

36. The system of claim 35, wherein the first regulated DC voltage has approximately the same magnitude and opposite polarity of the second regulated DC voltage.

37. The system of claim 36, further comprising means for converting the first regulated DC voltage and the second regulated DC voltage to an AC voltage to provide output AC power.

38. The system of claim 20, further comprising the first DC power source and the second DC power source with a source voltage of the first DC power source being of approximately equal magnitude and opposite polarity of a source voltage of the second DC power source.

39. A method of providing power to a load using an uninterruptible power supply (UPS) having a first input that can be selectively coupled to a first AC source, a second AC source, and a first DC source; the method comprising:

coupling the first input of the UPS to the first AC source and providing output power to a load based on AC power from the first AC source;

detecting a loss of the first AC source ;

coupling the first input of the UPS to the first DC source and providing output power
5 from the UPS based on DC power from the first DC source; and

transitioning a draw of input current at the first input from the first DC source to the second AC source by alternately coupling the first DC source and the second AC source to the first input of the UPS.

40. The method of claim 39, further comprising:

10 detecting return of the first AC Source;

transitioning a draw of input current at the first input from the second AC source to the first DC source by alternately coupling the second AC source and the first DC source to the first input of the UPS; and

transitioning a draw of input current at the first input from the first DC source to the
15 first AC source by alternately coupling the first DC source and the first AC source to the first input of the UPS.

41. The method of claim 40, wherein the UPS has a second input that can be selectively coupled to the first AC source, the second AC source, and a second DC source, the
20 method further comprising:

coupling the second input of the UPS to the first AC source and providing output power to a load based on AC power from the first AC source;

after detecting the loss of the first AC source, coupling the second input of the UPS to the second DC source and providing output power from the UPS based on DC power from
25 the second DC source; and

transitioning a draw of input current at the second input from the second DC source to the second AC source by alternately coupling the second DC source and the second AC source to the second input of the UPS.

30 42. The method of claim 41, further comprising:

detecting the return of the first AC Source;

transitioning a draw of input current at the second input from the second AC source to the second DC source by alternately coupling the second AC source and the second DC source to the second input of the UPS; and

- 5 transitioning a draw of input current at the second input from the second DC source to the first AC source by alternately coupling the second DC source and the first AC source to the second input of the UPS.